LightSAR: Convergence of Science, Applications and Commercial Requirements

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In March 1999, NASA issued an Announcement of Opportunity (AO) to develop and operate an Earth-imaging, lightweight synthetic aperture radar (LightSAR) mission for scientific investigations and commercial remote sensing. The solicitation was aimed at providing data for NASA Earth Science investigations, as well as expanding the market for commercial remote sensing. In addition, a stated goal in the Announcement was to demonstrate advanced SAR technologies and serve as a precursor for a commercial Earth-imaging SAR mission in the future.

The highest priority LightSAR science objectives are seismic and volcanic deformation mapping, vector ice sheet and glacier velocity mapping, topographic mapping and surface characterization, and hazard monitoring and assessment. Additional LightSAR science objectives are to monitor forest re-growth, estimate soil moisture and snow density, and map mesoscale ocean features. These objectives are all integral to the NASA's Earth Science Enterprise Program. LightSAR will provide global access and a capability to collect data over most places on Earth within 24 hours of a significant event (e.g. a volcanic eruption).

A LightSAR Science Working Group (LSWG) concluded that the highest priority LightSAR science objectives could best be accomplished by repeat-pass interferometry with a single polarization, L-band (24 cm wavelength) SAR. The LSWG also concluded that other high-priority science objectives, namely, the study of Earth's carbon and hydrologic cycles would benefit from the addition of polarimetry, and that oceanographic applications could best be achieved by incorporating a wide-swath mode (250-500 km).

Most of the calibration requirements for LightSAR were derived from SIR-C. However, the interferometric calibration is considerably more challenging. Radiometric calibration requirements are 3dB absolute and 1dB relative. Absolute phase calibration of 10 deg and a polarization isolation of -25 dB are also required when operating in polarimetric modes. To achieve surface displacement resolution of 2-5 mm statistical height error over any swath, sufficient orbital control is required to guarantee interferometric baselines less than 250 m, and < 10-cm orbit knowledge within one orbit is required. This tightly controlled repeat-pass capability will also provide valuable data for studies which use polarimetric interferometry.

In meeting these requirements, the LightSAR mission will be the first NASA mission specifically designed for measurement of surface change.